



MATHATRON[®]

**A NEW SIMPLICITY
IN ELECTRONIC COMPUTATION**

new simplicity and low cost electronic computation

The Mathatron is the first electronic computing device to provide the benefits of automatically programmed electronic digital computation plus the convenience and simplicity of operation of desk calculators in a single low cost unit. For less than \$5,000 (a fully equipped Mathatron 424 costs only \$3,490), you can have a complete stored program electronic digital computation center right at your fingertips that can produce useful results, immediately.

the new calculator language . . . Algebra

The field proven Mathatron is the only electronic calculator that lets you enter data and programs using ordinary mathematical notation including parentheses, just as they are used in algebra. It gives you a complete printed record of all calculations and solutions. (See the sample tape on the next page.)

solid-state reliability—automatic decimal point location

But that's not all. There are many other features that have made the Mathatron the choice of hundreds of organizations throughout United States, Canada, and the World. The program memory and individually addressable storage registers eliminate the need for manual re-entry of formulas, numbers, programs, or intermediate results. All answers are computed to at least 8 significant digit accuracy with a 2 digit power of 10 exponent. One hundred column number capacity (10^{-42} to 10^{+58}) virtually eliminates overflow problems. Frequently used formulas, sequences, or constants can be pre-wired and called in by touching a single button on the keyboard. Floating point arithmetic locates decimal points completely automatically.

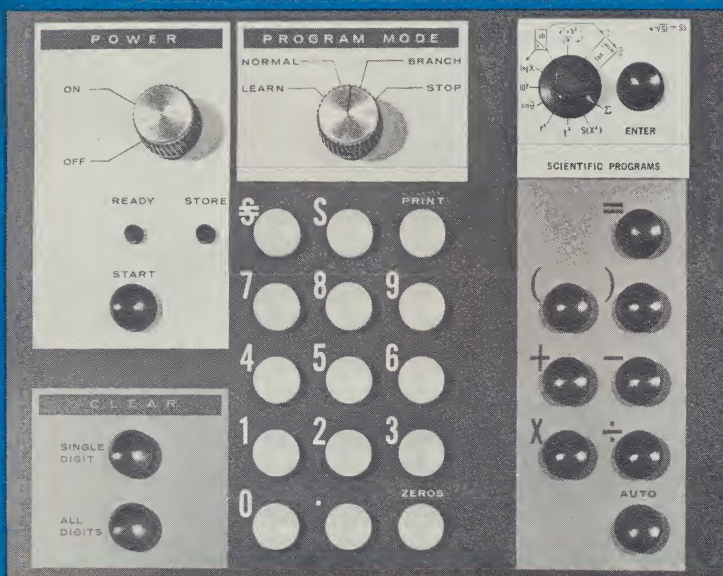
choice of input/output

And if that's not enough, you can choose any combination of input/output media to tailor the Mathatron to your specific computational needs. Output media include printed paper tape, page printout on 8½ inch wide paper to any length desired, 8 level punched paper tape, and direct connection to other devices through an electronic interface. Data may be entered directly through the Mathatron keyboard, through remotely located keyboards, by using punched paper tape, or directly through the Mathatron's electronic interface.

special models

If you're interested in mathematical, statistical, scientific, civil engineering, or surveying calculations there are special Mathatron models designed for maximum efficiency in these areas. If you're concerned with process control applications, there's a low cost Mathatron computational unit with direct electronic interface and rack mounting.

Whatever your computational problems may be, there's a Mathatron that can help you solve them efficiently and economically. Why not ask your Mathatron representative to arrange a demonstration for you in your office or laboratory. He'll be happy to show you how the Mathatron can save you time, money and effort.



The Mathatron keyboard provides ease of operation and great flexibility. By touching only 2 or 3 keys, data may be stored or retrieved at will. Simple or complex programs and formulas may be entered, stored, and reused as often as desired. Pre-wired programs and constants can be entered by touching a single key. Operator errors are easily correctable.

SAMPLE PRINTOUT OF "MORTGAGE SCHEDULE"

PRINCIPAL = 500.00

ANNUAL INTEREST RATE = .06

NUMBER OF PAYMENT PERIODS/YEAR = 4

AMOUNT/PAYMENT = 95.00

DATE	INTEREST	PRINCIPAL	BALANCE
	7.50	87.50	412.50
	6.19	88.81	323.69
	4.86	90.14	233.55
	3.50	91.50	142.05
	2.13	92.87	49.18
	.74	94.26	

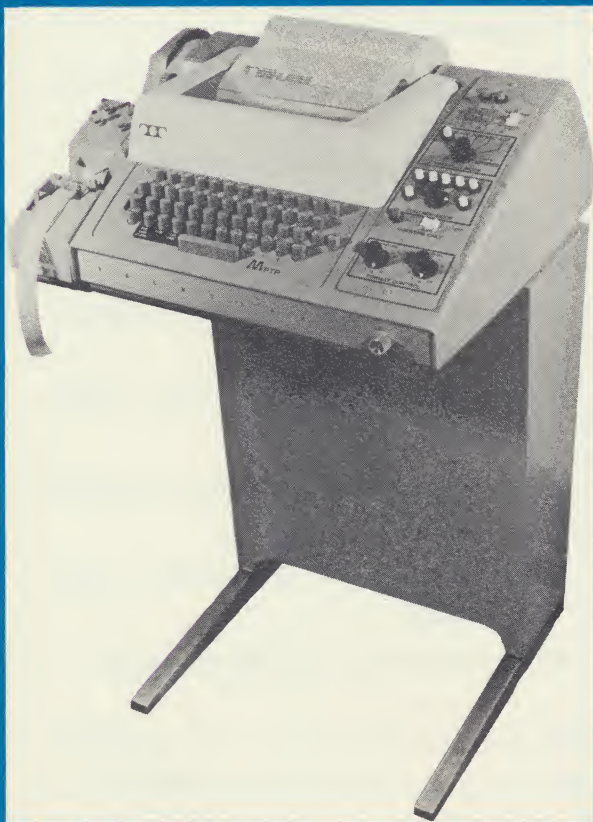
The Mathatron automatically provides a complete printed record of all calculations and solutions in easily readable form. Printed output can be stored for reference, mailed, or attached to other documents. Contents of storage registers may be printed out at any time for reference without affecting the calculation in process. Eight level punched paper tape can be produced as a by-product.

PARENTHICATION AND AUTOMATIC DECIMAL POINT
LOCATION ARE STANDARD FEATURES

COMPLEX NUM
WI

((25 + 8 X 12.5) 2 - 50) ÷ (1 - 2 X 8 ÷ 4) = - 66.666667

98546 X 81231



NUMBERS CAN BE STORED AND RE-USED
WITHOUT MANUAL RE-ENTRY

= S1 S1XS1XS1=512958703•21

Hundreds of Mathatrons are now in use handling a wide range of scientific, mathematical, statistical, engineering, and business computations, with speed, accuracy, and economy. Typical applications include:

- Determination of trigonometric functions
- Raising numbers to any power
- Solution of cubic, quadratic and fifth degree equations
- Evaluation of polynomials
- Simultaneous equations, matrix inversion
- Linear correlations
- Determination of standard deviations
- Correlations and distributions
- Radix conversions
- Great circle calculations
- Surveying and mapping calculations
- Estimation of operating costs, cash flow analysis
- Calculation of mortgage payment tables
- Evaluation of investment portfolios
- Determination of bond prices

Operating instructions are available on these and hundreds of others.



NUMBERS CAN BE STORED AND RE-USED
WITHOUT MANUAL RE-ENTRY

= S1 S1XS1XS1=512958703•21

The MATHATRON . . . a new concept in electronic computation . . .

INTERNAL OPERATIONS

Floating point arithmetic, built-in parenthecation, automatic decimal point location

SPEED

100 accumulations per second

NUMBER RANGE

100 columns . . . $\pm 10^{-42}$ to 10^{+58}

ACCURACY

Addition: 9 significant digits (not rounded)

Multiplication/Division: 9 significant digits; Results — 8 significant digits rounded

CIRCUITRY

Solid-state logic and circuitry, throughout

POWER REQUIREMENTS 424 OR 848 MODELS

200-300 watts, 105-125 volts, 50 or 60 cycle

COOLING REQUIREMENTS

none

DIMENSIONS 424 OR 848 MODELS

21½ inches wide, 25 inches deep, 13½ inches high

PROGRAM MEMORY CAPACITY

24, 48, or 480 steps

Mathematical operators: (), +, ×, −, ÷, each require 1 step; specifying storage register requires 2 steps in the 24 or 48 step option and requires 3 steps in the 480 step option.

STORAGE REGISTERS

4, 8, or 48 individually addressable registers

Each register can store a number with 9 significant digits plus a 2 digit power of 10 exponent, plus sign

INPUT MEDIA

Direct entry keyboard, 8 level punched paper tape, remote location keyboard, electronic interface

OUTPUT MEDIA

Printed paper tape, page printout on 8½ inch wide paper to length desired, 8 level punched paper tape, electronic interface

The Mathatron is sold and serviced by:

ask them for a demonstration in your office or laboratory.

MATHATRONICS, Inc 241-257 Crescent St. Waltham, Mass. 02154 U.S.A.

Telephone: (617) 893-1630

TWX 710-324-0265

CS-100

PATENTS APPLIED FOR

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MODELS SUBJECT TO CHANGE WITHOUT NOTICE



PTP

MATHATRON PTP

Paper tape Punch/Reader and Page Printer



For on and off line data recording, storage, and inter-machine communication

A versatile addition to the Mathatron family of low cost integrated data handling and digital computation equipment, the Mathatron PTP (Paper Tape Punch/Reader and Page Printer) extends the already wide range of capabilities of the Mathatron desk top computer. It provides low cost, off line data storage, flexible inter-machine communication media, and a choice of input/output media for the Mathatron.

Through the use of the PTP, tables, forms, and graphs can be automatically generated from complex equations. Surveying charts, for example, are automatically typed in columnar form with both input directions and angles shown with computed coordinates for each line. Complex engineering equations such as Bernoulli's equations, can be solved automatically using stored Mathatron programs with the tape punch and reader providing auxiliary storage.

Mathatron PTP – Paper Tape Punch/Reader and Page Printer

INPUT

Paper Tape Reader

Code: 8 level ASA
Reading Rate: 10 or 16 characters per second
Width: 1 inch

Typewriter Keyboard

Teletype Model 33

OUTPUT

Paper Tape Punch

Code: 8 level ASA
Punching Rate: 10 characters per second
Width: 1 inch

Page Printer

Paper Size: 8½ inches by any length desired
Printing width: 74 characters
Spacing: horizontal 10 characters per inch
vertical 3 or 6 lines per inch
Printing speed: 10 characters per second
Copies: original and one carbon
Tabulation: electronically controlled to space based on position of decimal point. See sample below;

THIS IS AN ACTUAL COMPUTATION PRINTOUT FROM THE MATHATRON PTP
DOING THE TRAVERSE CLOSURE PROBLEM IN THE 8-48C INSTRUCTION SUPPLEMENT.

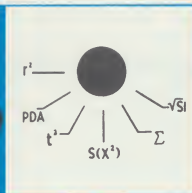
BEARING	DISTANCE	DEPARTURE	LATITUDE	ACC. DEP	ACC. LAT
803000	465.25	-458.869	76.788	-458.869	76.788
162730	295.32	83.669	283.219	-375.199	360.007
720900	259.33	246.846	-79.491	-128.353	280.516
771000	187.01	182.338	41.537	53.985	322.054
93000	326.63	-53.909	-322.150	.075	-.096

The Mathatron is sold and serviced by:

MATHATRONICS, INC.
Phone (617) 894-0835

257 Crescent Street

Waltham, Massachusetts 02154



MATHATRON STATISTICAL MODEL 8-48S

Reduces time and costs for statistical analysis and computation.

The Mathatron Statistical Model 8-48S provides a low cost yet highly efficient computing tool for business, governmental, scientific, and educational organizations involved with statistical computations such as summarizations, determination of averages, deviations, variances, correlations, etc.

An easy to use keyboard permits manual entry of constants, variables, and values. Solid-state computer logic and circuitry provide maximum reliability and all answers are computed to 8 or 9 significant digit accuracy over a range of 100 columns. Large number capacity virtually eliminates overflow problems. Eight independent storage registers may be used for the storage of intermediate results or constants or an-

swers. Special programs can be stored in the ferrite core memory storage for re-use as often as desired. A printed record tape of all calculations and solutions is automatically produced without any special programming.

When using the Mathatron Model 8-48S, you simply select the pre-wired program you want, enter your values and the Mathatron automatically does the rest for you at electronic speeds, giving you fast and accurate solutions with a minimum of effort.

Six special pre-wired programs are provided with the Mathatron Model 8-48S. The programs, used singly or in combination, simplify and speed the solution of such common problems as:

Program	Comments
1. Square Root	Computes and stores square root with provisions to fourth root.
2. Basic accumulations	Accumulates ΣX , ΣX^2 , ΣXY , ΣY , ΣY^2
3. Sum of squares	Accumulates $S(X^2)$, ΣX , ΣX^2 , Nx , $\bar{X}$, σ^2
4. T-test, pooled variance	Computes $(\bar{X} - \bar{Y})$, t^2
5. Paired data analysis	Computes Σd , Σd^2 , N , $\bar{d}$, $\Sigma d - \frac{(\Sigma d)^2}{N}$
6. Correlation coefficient	Computes r-correlation

Additional programs can be added to meet your specific requirements. The Mathatron Model 8-48S can also be used as a sophisti-

calated desk calculator for the solution of either simple or complex problems.



The problems below illustrate the ease of use of the Mathatron Model 8-48S

Problem: Determine Coefficient of Correlation

1. Select Basic Accumulator Program
2. Enter $X_1, Y_1, \text{AUTO}, X_2, Y_2, \text{AUTO}, \dots, X_n, Y_n$
3. Select Coefficient of Correlation Program
4. Enter N
5. Touch AUTO and the Mathatron will print $P(X,Y), S(X^2)$ and r^2
(Note: $P(X, Y) \div S(X^2)$ is the slope of the least squares line)
6. Select Square Root Program
7. Touch AUTO
8. Print r

Problem: Paired Data Analysis

1. Select $S(X^2)$ Program
2. Type $X_1 - Y_1 \text{ AUTO}, X_2 - Y_2 \text{ AUTO} \dots X_n - Y_n \text{ AUTO}$
3. Select Paired Data Analysis Program
4. AUTO (automatically prints $\bar{d}, \sigma^2, t_p^2$)
5. Select Square Root Program
6. Print t_p

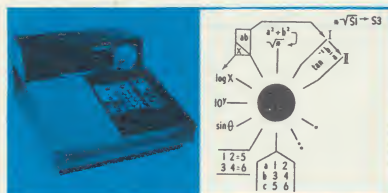
The Mathatron is a proven performer that can help you solve many of your computational problems. Ask your Mathatron representative for a demonstration.

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257 Crescent Street

Waltham, Massachusetts 02154



MATHATRON MATHEMATICAL MODEL 8-48M

Provides fast, automatic computation of common mathematical functions.

The Mathatron Mathematical Model 8-48M provides the mathematician, scientist or engineer with an easy to use and low cost computing tool which materially simplifies the solution of common mathematical functions, multiplies productivity, and completely eliminates the need for trigonometric or logarithmic tables.

An easy to use keyboard permits manual entry of constants, variables and values. Solid state computer logic and circuitry provide maximum reliability and all answers are computed in floating point to 8 or 9 significant digit accuracy over a range of 100 columns. This large number range permits truly automatic decimal point handling, and requires no special number

range or decimal point settings. The eight storage registers may be used for the storage of intermediate results and constants completely independent of the arithmetic process. Programs not pre-wired can be written in the ferrite core program memory from the keyboard for reuse as often as desired.

When using the Mathatron 8-48M, you simply select any of the 9 pre-wired programs, enter your values, and the Mathatron automatically does the rest for you at electronic speeds, giving you fast and accurate solutions with a minimum of effort.

The 9 pre-wired programs provided with the Mathatron Model 8-48 are:

Program	Comments
1. Two simultaneous equations	two simultaneous equations
2. 3 x 3 determinants	3 x 3 determinants, used for the solution of 3 simultaneous equations
3. Sine	also has special provisions for computation of cosine and tangent
4. 10^Y	constant for conversion to e^X automatically stored
5. $\log_{10}$	constant for conversion to $\log_e x$ automatically stored. Special provisions are included in the 10^Y and $\log_{10} y$ programs so they may be used together raising numbers to fractional powers such as $(3.45 \times 10^{-12})^{7.42}$
6. $a, b/x$	loader for log, square root and arc tan
7. Square root	$\sqrt{X}$ or $\sqrt{a^2 + b^2}$
8. Arc Tan I	Arc Tan (first segment)
9. Arc Tan II	Arc Tan (last segment)

These programs can be incorporated as needed in the solution of general problems. The Mathatron 8-48M can also be used as

a sophisticated desk calculator for the solution of either simple or complex problems depending on your particular needs.

The problems below illustrate the ease of use of the Mathatron Model 8-48 M

Problem: Sine 30.0145 degrees = .50021916

1. Select sine program.
2. Enter 30.0145 and touch AUTO key
3. Touch the = key

The problem and answer are printed out instantaneously on the Mathatron's paper tape:

30.0145 0 0 = .50021916

Problem: $\sqrt{(4.7)^2 + (8.23)^2} = 9.4774944$ $\tan^{-1} \frac{(8.23)}{4.7} = 60.2701$ degrees

1. Select a, b/x program
2. Enter 4.7 AUTO 8.23 AUTO
3. Select Square Root program
4. Touch AUTO
5. Print first answer
6. Execute $\tan^{-1}$ I and $\tan^{-1}$ II similarly, then touch =, which prints the second answer.

The problem and two results are printed on the Mathatron tape exactly as shown:

4.7 0 0 8.23 0 0 0 0 S3 = 9.4774944 0 0 0 0 = 60.270118

The Mathatron is already solving problems for leading research, engineering and business organizations throughout the country. Ask your Mathatron representative to show you how the Mathatron can simplify your figure work problems.

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NEW MATHATRON SCIENTIFIC MODEL 8-48SC

Cuts calculating costs for scientific, engineering, and statistical applications.

Designed to provide fast, accurate and economical solutions to common scientific, engineering, and statistical calculations, the Mathatron Model 8-48SC automatically provides a complete printed record of all calculations and solutions, eliminates programming problems, and frees personnel for more productive activities.

An easy to use keyboard permits the manual entry of constants, variables, and values. Solid-state computer logic and circuitry provide maximum reliability and all answers are computed to 8 or 9 significant digit accuracy over a range of 100 columns. Eight independent storage registers

may be used for the storage of constants or answers.

When using the Mathatron, you simply select any of the pre-wired programs, enter your values, and the Mathatron automatically does the rest for you at electronic speeds giving you fast, accurate solutions with a minimum of effort. Special programs can be stored for re-use as often as desired.

The 11 pre-wired programs, used singly or in combination, simplify and automate the solution of the common mathematical and statistical calculations:

Program	Comments
1. Basic Statistical Accumulator	$\Sigma X, \Sigma X^2, \Sigma XY, \Sigma Y, \Sigma Y^2$
2. Sum of Squares	$\Sigma X, \Sigma X^2, N_x, S(X)^2, \bar{X}, \sigma^2$
3. T-test	T-test, pooled variance
4. r-correlation	r-correlation
5. Sine	also has special provisions for computation of cosine and tangent
6. 10^Y	constant for conversion to e^x automatically stored, also special provision made to raise numbers to fractional powers
7. $\log x$	$\log_{10} x$ or $\log_e x$
8. $a, b/x$	loader for log, square root and arc tan
9. Square Root	$\sqrt{X}$ or $\sqrt{a^2 + b^2}$
10. Arc Tan I	arc tan (first segment)
11. Arc Tan II	arc tan (last segment)

The Mathatron Model 8-48SC may also be used as a sophisticated desk calculator for the solution of both simple and complex

problems depending on your particular needs.

The problems below illustrate the ease of use of the Mathatron Model 8-48SC

Problem: Sine 30.0145 degrees = .50021916

1. Select sine program.
2. Enter 30.0145 and touch AUTO key
3. Touch the = key

The problem and answer are printed out instantaneously on the Mathatron's paper tape:

30.0145 0 0 = .50021916

Problem: $\sqrt{(4.7)^2 + (8.23)^2} = 9.4774944$ $\tan^{-1} \frac{(8.23)}{4.7} = 60.2701$ degrees

1. Select a, b/x program
2. Enter 4.7 AUTO 8.23 AUTO
3. Select Square Root program
4. Touch AUTO
5. Print first answer
6. Execute $\tan^{-1}$ I and $\tan^{-1}$ II similarly, then touch =, which prints the second answer.

The problem and two results are printed on the Mathatron tape exactly as shown:

4.7 0 0 8.23 0 0 0 0 S3 = 9.4774944 0 0 0 0 = 60.270118

The Mathatron is already solving problems for leading research, engineering and business organizations throughout the country. Ask your Mathatron representative to show you how the Mathatron can simplify your figure work problems.

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APS

MATHATRON AUXILIARY STORAGE OPTION

Provide increased speed, efficiency, and simplicity of operation.

The Mathatron is the only electronic calculator that can be expanded to meet increased computational requirements.

When computational needs outgrow the Mathatron 8-48, the Mathatron Auxiliary Program Storage Option can be added for increased speed, extra capacity, and even greater operational efficiencies. The Mathatron APS Option when added to a Mathatron 8-48 not only results in a total of 480 steps of program memory and 48 individually addressable storage registers, but also additional program control capability.

Employing the same reliable solid-state control circuitry as the Mathatron, the APS unit is housed in a self-contained metal stand which forms a convenient base for the Mathatron. As with all Mathatron equipment, the APS Option is fully compatible and programs being run on the Mathatron 8-48 may be operated without change.

Each of the 48 storage registers is addressed by the same procedure used in the 8-48, one extra digit is added to allow 2 digit addresses instead of 1 digit addresses where necessary. Pre-wired programs in the 8-48 are not only compatible but may also be used as subprograms in the 480 step memory. Each register stores a standard Mathatron number (sign and 11 digits consisting of a 9 digits and a 2 digits power of 10 exponent).

The program memory of the Mathatron 8-48 with Auxiliary Program Option is organized in 10 banks or loops of 48 steps each for a total of 480 steps. Storage register reference require 3 steps, mathematical operations such as $(,)$, $+$, $\times$, $-$, $\div$ use only 1 step each. During execution, a master program can branch to subprograms, execute them and then continue

along the original path—all automatically. Up to 18 pre-wired programs of 48 steps each may be incorporated into the system. These programs are divided into two types, A and B. Type A programs are automatically executed when called, and do not use any of the 480 program steps. Type B programs are loaded directly into loop 0.

A few of the many programs which benefit from the addition of the Mathatron APS Option to the Mathatron 8-48 are:

STATISTICAL

- multiple correlations
- curve fitting
- analysis of variance
- quality control calculations

MATHEMATICAL AND ENGINEERING

- solution of simultaneous equations, small matrix manipulations (3 and 4 for all unknowns, 5 for 1 unknown)
- solution of polynomial equations
- automatic evaluation of complex mathematical formulae, involving trigonometric, logarithmic and other functions
- great circle calculations
- analysis of orbits and trajectories
- trigonometric functions, solutions of triangles
- triangulation
- analysis of stresses and moment distributions

OTHER

- sales forecasting and analysis
- cash flow analysis

The added convenience, flexibility, capacity, and ease of operation supplied by the Mathatron APS Option fully justify its modest cost of \$2,900. Combined with the outstanding computational capabilities of the Mathatron 8-48, it provides the user with an electronic computational device which solves either simple or complex problems with maximum ease, efficiency and economy.

Summary of Mathatron APS Program Memory Control Functions

A. Branch to any one of the 10-48 step loops

1. Unconditionally: go to loop specified
2. Conditionally:
 - a. go to the next highest loop (test ≥ 0)
 - b. go to specified loop (test < 0)

B. Branch from master program to subprogram, beginning at loop specified and return

C. Subprogram return to master program

1. Test:
 - a. go back to master program (test ≥ 0)
 - b. repeat same loop (test ≤ 0)
2. continue subprogram at specified loop
3. Continue subprogram at next highest loop
(loop 9 goes to loop 0)

D. Go to next highest loop (loop 9 goes to 0)

E. Transfers

1. Put specified loop into loop 0
2. Put contents of loop 0 into specified loop

F. Pre-wired programs

1. Type A: execute specified pre-wired program
2. Type B: write specified pre-wired program into loop 0

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PTP

MATHATRON PTP

Paper tape Punch/Reader and Page Printer



For on and off line data recording, storage, and inter-machine communication

A versatile addition to the Mathatron family of low cost integrated data handling and digital computation equipment, the Mathatron PTP (Paper Tape Punch/Reader and Page Printer) extends the already wide range of capabilities of the Mathatron desk top computer. It provides low cost, off line data storage, flexible inter-machine communication media, and a choice of input/output media for the Mathatron.

Through the use of the PTP, tables, forms, and graphs can be automatically generated from complex equations. Surveying charts, for example, are automatically typed in columnar form with both input directions and angles shown with computed coordinates for each line. Complex engineering equations such as Bernoulli's equations, can be solved automatically using stored Mathatron programs with the tape punch and reader providing auxiliary storage.

Mathatron PTP – Paper Tape Punch/Reader and Page Printer

INPUT

Paper Tape Reader

Code: 8 level ASA
Reading Rate: 10 or 16 characters per second
Width: 1 inch

Typewriter Keyboard

Teletype Model 33

OUTPUT

Paper Tape Punch

Code: 8 level ASA
Punching Rate: 10 characters per second
Width: 1 inch

Page Printer

Paper Size: 8½ inches by any length desired
Printing width: 74 characters
Spacing: horizontal 10 characters per inch
vertical 3 or 6 lines per inch
Printing speed: 10 characters per second
Copies: original and one carbon
Tabulation: electronically controlled to space based on position of decimal point. See sample below;

THIS IS AN ACTUAL COMPUTATION PRINTOUT FROM THE MATHATRON PTP
DOING THE TRAVERSE CLOSURE PROBLEM IN THE 8-48C INSTRUCTION SUPPLEMENT.

BEARING	DISTANCE	DEPARTURE	LATITUDE	ACC. DEP	ACC. LAT
803000	465.25	-458.869	76.788	-458.869	76.788
162730	295.32	83.669	283.219	-375.199	360.007
720900	259.33	246.846	-79.491	-128.353	280.516
771000	187.01	182.338	41.537	53.985	322.054
93000	326.63	-53.909	-322.150	.075	-.096

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